

A new species of *Penaincisalia* (Lepidoptera: Lycaenidae) from Peru

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Abstract. The penelfin *Penaincisalia alina* sp. nov. is described from Department Apurímac, Peru on the basis of wing and genitalia characters. Spectral analysis of structural colours carried out on congeneric species is presented. A hitherto unnamed *Penaincisalia* species from the vicinity of the type locality is also documented.

Keywords. Andes, diversity, Eumaeini, genitalia, light reflectance, structural colour.

INTRODUCTION

The genus *Penaincisalia* was established by Kurt Johnson for 13 nominal species with the type species *Thecla culminicola* Staudinger, 1894 (Johnson 1990). Subsequently in a monograph of Andean Eumaeini Johnson elaborated the relatives of *Penaincisalia* and described additional species and established further genera (Johnson 1992). In a checklist, many species- and genus-group names proposed by Johnson for *Penaincisalia* and its relatives (= penelfins) were placed in synonymy but, amongst the 41 recognized “*Penaincisalia*” species there have been indicated 18 species as undescribed (Robbins 2004).

In his doctoral thesis Carlos Prieto (2008) revised the whole assemblage on the basis of the biogeography, taxonomy and phylogeny of the group, and recognized many of the genera proposed by Johnson as monophyletic species-groups, including the *culminicola* species group (= *Penaincisalia* s. str.) (Prieto *et al.* 2008, 2011 and 2016). As the phylogeny of “*Penaincisalia*” was not fully resolved, the generic concept of Robbins has been used in most species descriptions subsequent to the checklist (Hall *et al.* 2005, Prieto 2007, 2010), but a different view of generic

concept has also been expressed (Bálint *et al.* 2005, Bálint 2005, Prieto & Bálint 2007, Bálint *et al.* 2008a, 2008b). Although, since the publication of the checklist eleven new species group names have been proposed in *Penaincisalia* sensu Robbins, it is evident, that the species diversity of penelfins has been not fully documented yet.

In 2019, Vyacheslav Doroshkin (Russia, Chelyabinsk) sent a male specimen of *Penaincisalia* s. str. for investigation to the Hungarian Natural History Museum (HNHM; registered as loan 2019-37). In the HNHM there are 55 specimens (amongst them 11 have been dissected) representing *Penaincisalia* s. str. Comparing with this material and literature sources, on the basis of wing and genitalia characters the specimen collected by Mr. Doroshkin proved to be an undescribed species. In searching additional specimens Dr. Gerardo Lamas (Lima, Peru) sent information via personal communication that in the Museo de Historia Natural, Universidad Nacional Mayor de San Marcos (Lima, Peru) (MUSM), there are three male and one female *Penaincisalia* specimens probably from the same locality. It seems that these specimens represent a different species. The aims of the present paper are (1) to name the species collected by the

Russian lepidopterist, (2) to describe the species, and (3) to discuss the characters of the new species and compare with the specimens of the MUSM.

TAXONOMY

Penaincisalia alina Bálint, sp. nov.

(Figures 1–3, 18–19)

Type material. Holotype, male (at the moment in HNHM, but will be deposited in MUSM), set dorsally, in good condition (right antenna missing, right wings slightly worn), labelled as "Peru Pass Abancay Cusco [//] H – 4000 [//] 10. 12. 2000. V. Doroshkin leg." (rectangular label, black print on white paper) (Figs. 1–2, 18–19). The holotype is dissected (HNHM Lepidoptera Bálint gen. prep. no. 1659).

Diagnosis. This species is unique in the genus in possessing the following combination of characters: (1) the dorsal wing surface is dark rufous brown with a violet reflection when viewed at a shallow angle (*P. perezi* Bálint, 2001 has a similar reflection, but the dorsal wing surface of that species is orange; see Figs. 18–19 and 22–23); (2) ventral wing surface is dark brown with a somewhat lighter area in the forewing below the cubital vein (*P. alatus* Druce, 1907 described from Ecuador has similarly dark underside but it is not brown but grey, and the dorsal wing surfaces of that species are deep violet blue; Figs. 6–7). Similar congeneric species are either dorsally blue, violet or orange, and ventrally somewhat differently coloured and patterned (e.g., Figs. 8–17). (3) The male genitalia valva has the lower margin rectangular, a unique character in the *culminicola* species group, as all the other species have different valval shape (Fig. 3).

Description. Male. Head, thorax and abdomen black on dorsal side; thorax and abdomen with greyish pubescence on ventral side; antenna with 0.6 time length of forewing costa, clubs black. Forewing length 12 mm, measured from the base of cubital vein to vein R₃ terminus, triangular in

shape. Ground colour on dorsal surface dark rufous brown with violet iridescence (depending on the direction of illuminating light) (Figs. 18–19); margins with thin (< 2 mm) black border, broadening in apical areas in both wings; fringes lighter brown. Androconia present as scent pad trapezoid in shape in the apical part of the discal area, and as minute scent patch in the erection of vein M₃. Forewing ventral surface warm brown with delicate discoidal patch and black, sharp and slightly ruptured postmedian line and somewhat lighter median area below the cubitus; hindwing basal and medial band black, ruptured and sharply marked; antemarginal line appearing as continuous intercellular black arrowhead marks bordered distally by lighter brown crescent pattern; fringes brown (Figs 1–2). In male genitalia tegumen and uncus large when seen from lateral and dorsal aspects; gnathos straight when seen from lateral but curved when seen from ventral side, with a formation appearing as rounded plate in dorso-ventral view before the pointed apex; valva slender, as long as tegumen, with straight upper and angled lower margins, length of narrow apical part one third the length of the valva; vinculum slender but well sclerotized, saccus membranous and short (with the length of narrow valval apical part); aedeagus slender with valva length slightly more than two times and two apical cornuti (Fig. 3). Female. Unknown.

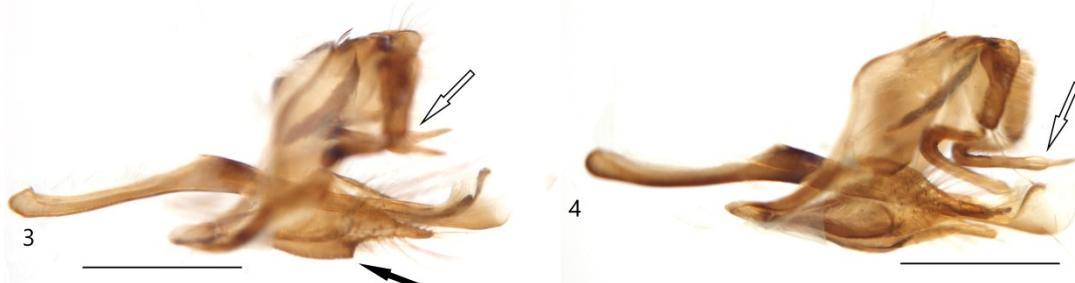
Distribution. Geographic: Known only from the type locality "Abancay Pass" (= a high pass on the paved road between Abancay and Cusco, department Apurímac; the approximate coordinates of the collecting site are: 13°35'05.7"S 72°49'08.0" W) (Fig. 5). Spatial: The label data indicate that the type specimen was captured at 4000 m elevation. Temporal: The holotype was collected in the first half of December.

Bionomics. A series of *Yramea inca* (Staudinger, 1894) (Heliconiinae) was collected at the same time and place as the holotype.

Etymology. By request, this species is named after Alina Doroshkin, daughter of the collector. The name is treated as a feminine nominative noun in apposition.



Figures 1–2. *Penaincisalia alina* sp. nov. Holotype. 1 = recto; 2 = idem, verso. The violet sheen of the dorsal wingsurfaces was not caught by the camera because of the light conditions (for colour reflection see Figs. 8–9) (scale: 10 mm).



Figures 3–4. Male *Penaincisalia* genitalia capsule and aedeagus in dorsal view, in same magnification. 3 = *P. alina* sp. nov. (holotype; Bálint gen. prep. no. 1659) (a black arrow indicates the genitalia character of *P. alina*; white arrows point to gnathos before the pointed terminus, what showing a character state to be the supposed apomorphy of *Penaincisalia* s. str.) 4 = *P. aurulenta* K. Johnson, 1990 (Peru, Llanganuco; Bálint gen. prep. no. 1660) (scale bars = 0.8 mm).

DISCUSSION

Characters

Prieto demonstrated for several *Penaincisalia* species groups that, although the male genitalia differences were quantitative, they were sufficient for species recognition (Prieto *et al.* 2008, 2016). This statement stands also for *Penaincisalia* s. str. (the *culminicola* species group). We had insufficient material to enable a statistically sound comparative analysis of the genitalia traits, but it seems that *P. alina* male genitalia is distinctive enough in having the lower valval margin angulated, a unique character in the group (Figs. 3–4; for comparison see the figures in Johnson 1990 and 1992, and Prieto 2008).

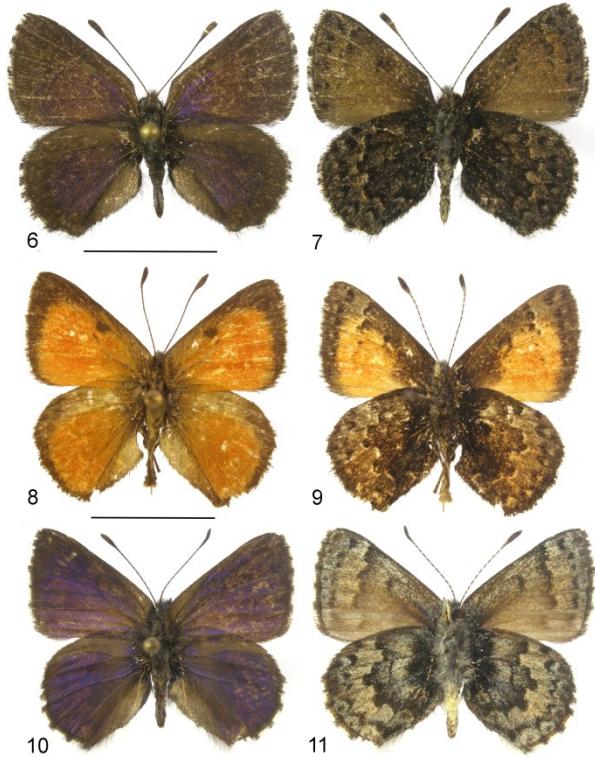
The differences in male dorsal wing colour seem to be the most distinctive, and on the basis

of this character syntopic and synchronic species can be immediately discriminated even in the field. For example, in the Llanganuco valley (Cordillera Blanca, Ancash, Peru) the penelfins (*P. aurulenta* Johnson, 1990; *P. biophot* Bálint & Wojtusiak, 2008; *P. lamasi* Bálint, 2001 and *P. perezi*) were able to be distinguished by the observer in flight, when they were on wing on the same day (Bálint 1995 and 1997; cf. Bálint *et al.* 2008b).

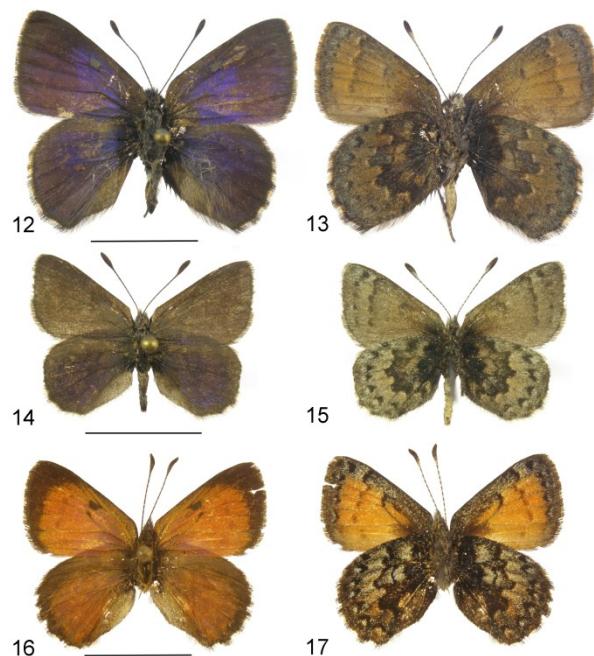
Syntopic, closely related (congeneric) species having distinctive male dorsal coloration might be a general phenomenon in Lycaenidae, but when the colours are identical species are often allopatric or allochronic (cf. Bálint *et al.* 2012, 2014), and the phenomena discoloration (Biró *et al.* 2003) or reinforcement (Lukhtanov *et al.* 2005) play the role. This should be also the case for *Penaincisalia* s. str., when traits determined by



Figure 5. “Abancay”, in department Apurímac, the type locality of *Penaincisalia alina* sp. n. as situated geographically in Peru.



Figures 6–11. Males of various *Penaincisalia* species from Peru for comparison. Scales: 10 mm. 6–7 = *P. alatus* (Druce, 1907) (dorsal wingsurfaces deep violet with wide black margin): 6 = recto, 7 = verso (Peru, Cordillera Blanca, above Huanuco); 8–9 = *P. aurulenta* K. Johnson, 1990 (dorsal wingsurfaces orange with goldish shade): 8 = recto, 9 = verso (Peru, Cordillera Blanca, Llanganuco); 10–11 = *P. biophot* Bálint & Wojtusiak, 2008 (dorsal wingsurfaces light deep violet): 10 = recto, 11 = verso (paratype, Peru, Cordillera Blanca, Llanganuco).

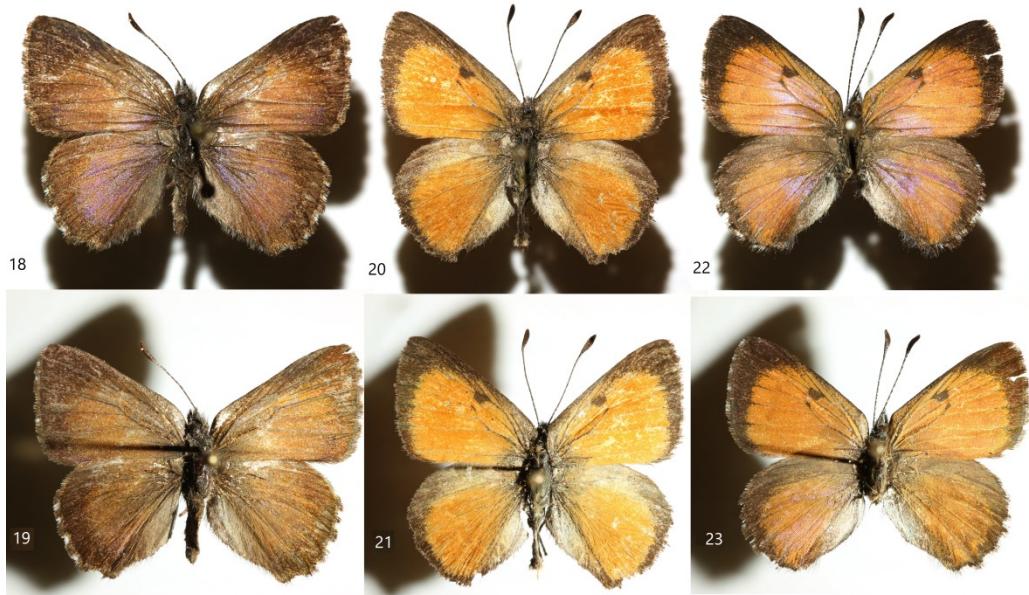


Figures 12–17. Males of various *Penaincisalia* species from Peru for comparison. Scales: 10 mm. 12–13 = *P. culminicola* (Staudinger, 1894) (dorsal wingsurfaces light violet with thin black margin): 12 = recto, 13 = verso (Peru, Apurímac, Saywite); 14–15 = *P. lamasi* Bálint, 2001 (dorsal forewing-surface black, hindwing forewingsurface light blue): 14 = recto, 15 = verso (Peru, Cordillera Blanca, Tingo Pampa); 16–17 = *P. perezi* Bálint, 2001 (dorsal wingsurface orange with pink shade): 16 = recto, 17 = verso (Peru, Cordillera Blanca, Llanganuco).

pigments and nanoarchitectures are lost or regained multiple times (*cf.* Bálint *et al.* 2005, 2008a, b).

Light reflectance and structural colours

The ground scales of the species *P. aurulenta* and *P. perezi* contain yellow pigment, whilst *P. alina* scales do not. The yellow colour is most distinctive in the measurement under normal incidence, and this is also distinctive in the Figures 18–23 and 24. The scales of the species *P. alina* and *P. perezi* possess photonic nanoarchitectures, and the identical spectra of the reflected blue colour suggest that their nanoarchitectures are identical. The spectra of these two species under normal incidence show difference in the region where the reflectivity of the pigments are (> 500 nm): *P. perezi* is yellow, whilst *P. alina* is



Figures 18–23. Male specimens of the known orange *Penaincisalia* species photographed under normal (90°) and 45° light incidence. 18–19 = *P. alina* sp. n., 20–21 = *P. aurulenta*, 22–23 = *P. perezi*. The direction of illumination is indicated by the black shadow situated under the specimens: 90° = there is shadow under the specimen, 45° = there is shadow only on the left side. Under 45° light incident the structural colour is not visible.

brown. Therefore the spectrum of *P. alina* is more similar to the spectra of blue *Penaincisalia* species investigated previously (Bálint *et al.* 2008b).

In the cases of *P. biophot* and *P. culminicola* we know that the ground scales are heavily packed with melanin producing brown colour, but the cover scales possess photonic architectures reflecting the light with much higher directionality.

Diversity

Members of *Penaincisalia* s. str. inhabit high altitudes in the Andes from central Colombia via Ecuador, Peru and Bolivia to northwest Argentina and northeast Chile. The adults of these species are small with structurally or pigmentally coloured dorsal and cryptically patterned ventral wing surfaces, and with a gnathos having a widening subterminal plate before the pointed apex in a state, what is probably the synapomorphy of the group (see Figs. 3–4) (Bálint, *in prep.*). Males possess a double androconial spot in the distal part of the forewing discalis. Because the habitats

where these species dwell are difficult to access, the weather conditions are often unfavourable for sampling, and the flight periods of the species are short, this group is under-represented in museum collections. As a result, the taxonomy of *Penaincisalia* sensu Robbins remains rather poorly understood and the diversity of the species groups have yet to be adequately documented.

Based on records collected in the Llanganuco valley, Peruvian Cordillera Blanca, which is one of the best explored Andean valley in high altitudes from the aspect of butterfly faunistics (Lamas & Pérez 1983), it seems that five *Penaincisalia* species occur synchronically and syntopically (*cf.* Bálint 1995 and 1997) (see Figs. 8–17). These species differ in ventral wing pattern and genitalia morphology but the male dorsal wing surface coloration is the most distinctive (*cf.* Bálint 2001; see Fig. 24). Most recently Dr. Tomasz Pyrcz (Krakow, Poland) in June 2019 conducted faunistic surveys also in the Cordillera Blanca region where he was able to detect six *Penaincisalia* species, one of them seems to be undescribed.

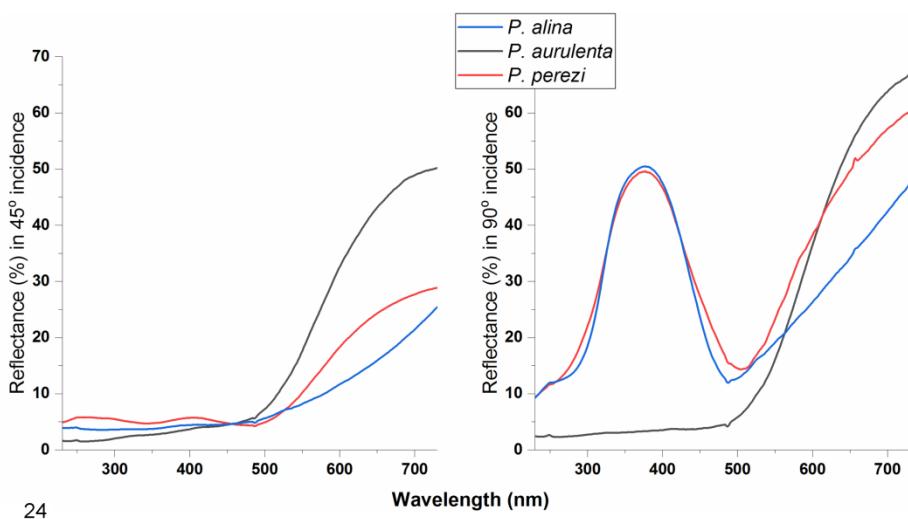


Figure 24. The spectral diagrams of the three *Penaincisalia* species as depicted in Figs. 18–23. Detailed explanation is given in the main text.



Figures 25–28. Documentation of an undescribed orange *Penaincisalia* species from Apurímac, Peru. 25 = male, recto, 26 = idem verso, 27 = female, recto, 28 = idem, verso (courtesy: MUSM) (scale: 10 mm).

The *Penaincisalia* specimens, collected in or in the vicinity of *P. alina* type locality and deposited in MUSM, most probably represent a hitherto unnamed species. This species is close to *P. aurulenta*, but the representative specimens have no goldish hue on the dorsal wing surfaces, they are plain orange and the wing undersides somewhat differently coloured and patterned. The species cannot be described as at the moment we

have no access to these specimens, but because of Dr. Lamas' kindness we can document the species in this paper (Figs. 25–28).

We do not know yet what other *Penaincisalia* s. str. species may occur there, but there are records for *P. culminicola* from department Apurímac, which is a species with violet male dorsal wingsurfaces and yellowish forewing ventral wingsurface (Figs. 12–13).

The descriptions of the undescribed species from Peruvian Cordillera Blanca and Ampay regions will be the task of the next study on *Penaincisalia*. This will be another step for having a better understanding of this peculiar high Andean group of lycaenid butterflies.

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